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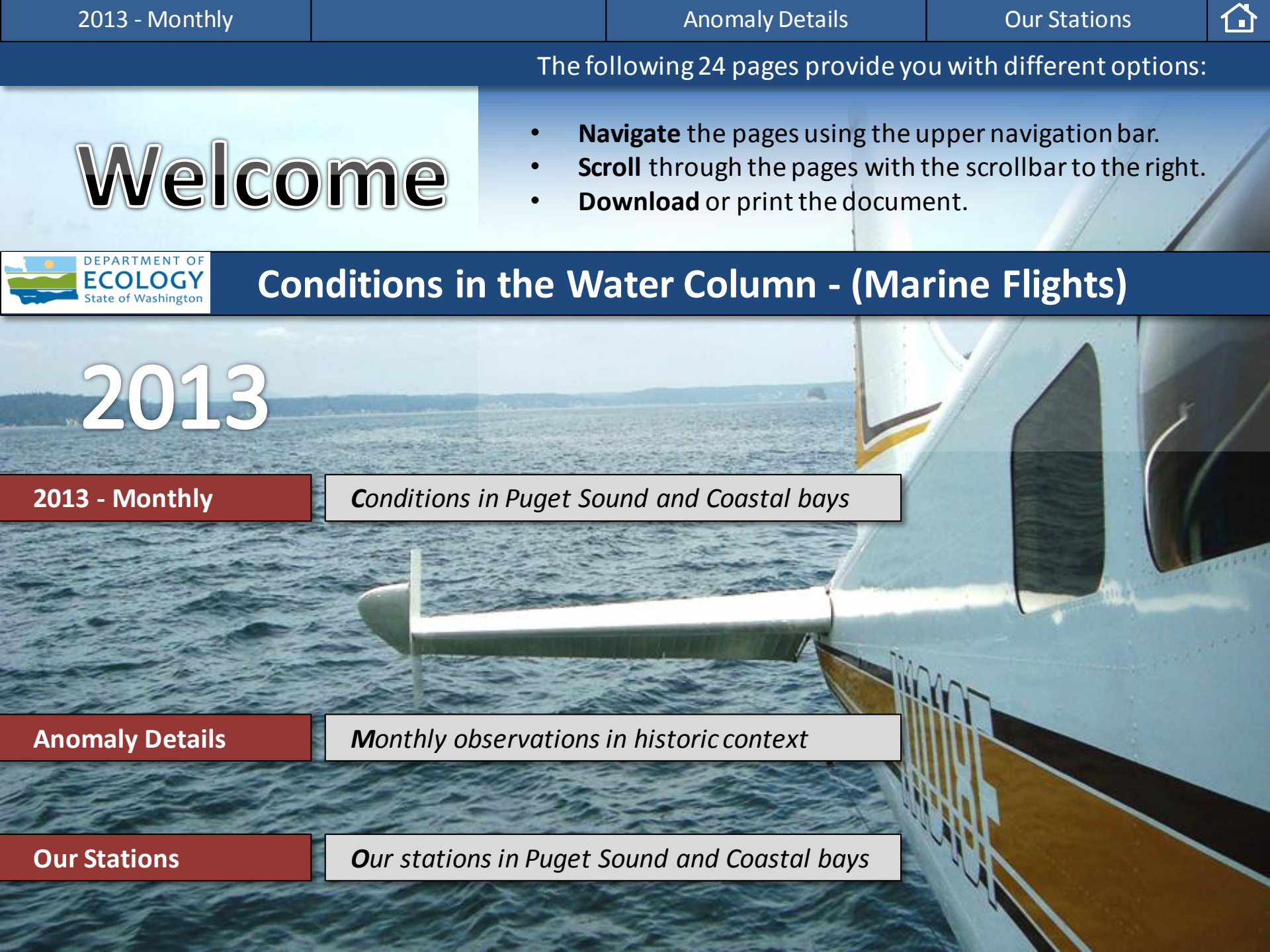
DEPARTMENT OF ECOLOGY State of Washington

Conditions in the Water Column - (Marine Flights)

2013



2013 - Monthly — *Conditions in Puget Sound and Coastal bays*

Anomaly Details — *Monthly observations in historic context*

Our Stations — *Our stations in Puget Sound and Coastal bays*

Meteorological conditions: January started and ended warm, but was colder than normal for the most part. Precipitation and river flow varied but were close to normal. Both indices Upwelling (anomalies) and PDO are moving to normal.

SUMMARY GREATER PUGET SOUND REGION - Fresher and less dense water most pronounced at depth. Higher DO levels remaining in the deepest portions, lower DO levels in surface/shallow layers and in Hood Canal. Transmission is slightly lower in the North, higher in Central Sound, and expected in South Sound. In situ fluorescence is only higher in Hood Canal.

1. **San Juan-North Sound Region:** Sign fresher and less dense. Higher DO restricted to greater depth outside PS proper, lower DO in surface and shallow layers.
2. **Central Sound Region:** Sign fresher and less dense in the deeper layers. DO higher at depth, lower in surface and shallow layers. Water transmission is significantly higher.
3. **Whidbey Basin:** Very low salinity and density and higher water transmission. DO concentrations varying around expected ranges.
4. **Hood Canal:** Very low salinity and density confined to deeper water. Overall lower DO but higher transmission and in situ fluorescence.
5. **South Sound:** Fresher and less dense with otherwise expected conditions.

SUMMARY COASTAL BAYS REGIONS – not available

1. **Grays Harbor:** not available
2. **Willapa Bay:** not available

Meteorological conditions: February was cloudy with lower than normal precipitation and river flow. Air temperatures fluctuated around expected conditions.

SUMMARY GREATER PUGET SOUND REGION – Largely expected physical condition with lower DO levels confined to the North and in Hood Canal. Both transmission and in situ fluorescence were higher.

1. **San Juan-North Sound Region:** Lower DO, especially in Admiralty Inlet. Higher DO levels associated with a bloom confined to Bellingham Bay. Overall transmission and in situ fluorescence were higher.
2. **Central Sound Region:** Both transmission and in situ fluorescence higher than expected.
3. **Whidbey Basin:** Warm surface temperatures, cold at depth. IN situ fluorescence higher than expected.
4. **Hood Canal:** Warmer surface temperatures and lower salinity and density at depth. Higher transmission and low DO levels.
5. **South Sound:** Both transmission and in situ fluorescence higher than expected.

SUMMARY COASTAL BAYS REGIONS - Largely expected physical conditions. Only in situ fluorescence was higher.

1. **Grays Harbor:** Both transmission and in situ fluorescence higher than expected
2. **Willapa Bay:** Expected conditions

Meteorological conditions: High variability. Cool and cloudy, warm and cloudy, cool and sunny, warm and sunny… one week of each! Rivers were low, came up above normal, then receded again.

SUMMARY GREATER PUGET SOUND REGION – Largely expected physical conditions with variable DO conditions - higher in North and lower in Whidbey & Hood Canal surface waters. In situ fluorescence was variable with higher biomass in the Northern sound, lower in Whidbey and Hood Canal.

1. **San Juan-North Sound Region:** In situ fluorescence every high. Low transmission confined to Bellingham bay and Rosario Passage .
2. **Central Sound Region:** Expected .
3. **Whidbey Basin:** Variable temperature lower DO especially in surface, otherwise expected.
4. **Hood Canal:** Variable salinity and transmission. Lower DO in northern surface water. Lower in situ fluorescence except at the surface at southern stations.
5. **South Sound:** Higher water transmission.

SUMMARY COASTAL BAYS REGIONS – Higher oxygen and higher in situ fluorescence in Willapa Bay

1. **Grays Harbor:** Higher oxygen levels.
2. **Willapa Bay:** Higher oxygen and in situ fluorescence otherwise expected .

Meteorological conditions: April was a mostly cloudy with one week of sunshine toward the end. Precipitation and river flows were above normal. Air temperature was variable with the warm spell coinciding with the period of sunshine.

SUMMARY GREATER PUGET SOUND REGION - Anomalies in density and salinity restricted to northern portions of the Sound and the Straits. Variable oxygen in the north and Whidbey Basin. In situ fluorescence was regionally variable.

1. **San Juan-North Sound Region:** Higher salinity and density at depth. Lower oxygen at depth. In situ fluorescence variable but outside expected ranges.
2. **Central Sound Region:** Largely expected conditions.
3. **Whidbey Basin:** Largely expected conditions but higher oxygen conditions.
4. **Hood Canal:** Largely expected conditions.
5. **South Sound:** Higher salinity and density restricted to Carr Inlet. Higher in situ fluorescence.

SUMMARY COASTAL BAYS REGIONS - Warmer. Lower than expected salinity restricted to Grays Harbor river influenced stations. Both DO and in situ fluorescence lower than expected.

1. **Grays Harbor:** Warmer, fresher and less dense. Lower DO and variable but unexpected in situ fluorescence.
2. **Willapa Bay:** Warmer temperatures, lower in situ fluorescence with lower DO restricted to the central bay area.

Meteorological conditions: The first half of May was unseasonably warm, and the second half cool. The warm period was mostly sunny with little precipitation. Wind was mostly from the north and upwelling favorable. Rivers were generally running above normal except for the Chehalis on the coast.

SUMMARY GREATER PUGET SOUND REGION – Warmer surface temperature in San Juan I., Central, and South Sound. Lower DO in the North Puget Sound, North-Central, Whidbey Basins & Hood Canal. Fluorescence was lower with elevated concentrations only in Carr Inlet to East Passage. Higher transmission in Central regions.

1. **San Juan-North Sound Region:** Higher temperatures confined to San Juan Islands. Lower DO everywhere.
2. **Central Sound Region:**. Higher temperatures confined to Elliott Bay and vicinity. Fluorescence was lower and transmisivity was higher.
3. **Whidbey Basin:** Lower DO and lower fluorescence and transmission was higher.
4. **Hood Canal:** Lower DO, especially near the surface. Distinct lack of seasonal DO super saturation and high transmission near surface.
5. **South Sound:** High temperature confined to surface. Higher DO at Commencement Bay. Seasonal super-saturation ubiquitous through basin.

SUMMARY COASTAL BAYS REGIONS - Higher temperature and lower DO and fluorescence. Transmission was variable but unexpected.

1. **Grays Harbor:** Higher temperature, lower salinity and density. Low DO near river. Lower overall fluorescence.
2. **Willapa Bay:** Higher temperature, low DO and low fluorescence but variable transmission.

Meteorological conditions: Warming above expected values at end of June yet lower sun shine most of the month. June has been dry with rivers falling below expected values. Rain starting again in the last part of the month resulting in higher than expected river flows.

SUMMARY GREATER PUGET SOUND REGION - Lower DO in N. Sound, Whidbey Basin surface, and N. Central Sound. Seasonal super-saturation present almost everywhere. transmission variable and unexpected in South Sound.

1. **San Juan-North Sound Region**: Lower DO particularly in San Juan I..
2. **Central Sound Region:** Higher temperature and lower DO except in Commencement Bay. Transmission higher in Northern Central Sound, and lower in East Passage and Commencement Bay. Fluorescence low near Elliott Bay and Sinclair Inlet.
3. **Whidbey Basin:** Warmer temperature lower density and lower Chl a confined to the surface.
4. **Hood Canal:** Fluorescence is lower otherwise expected.
5. **South Sound:** Expected

SUMMARY COASTAL BAYS REGIONS - Lower DO except near river sites.

1. **Grays Harbor:** Expected
2. **Willapa Bay:** Expected

Meteorological conditions: Sunny and dry with near average air temperatures. River flow has been below average except on the Nisqually (snow melt) and the Chehalis. Winds are upwelling favorable.

SUMMARY GREATER PUGET SOUND REGION - Mostly expected with some warm temperatures at the surface. Higher DO in surface waters at sites in Central, South & Whidbey Basins & Hood Canal. Fluorescence was regionally variable.

1. **San Juan-North Sound Region:** Mostly expected, yet higher fluorescence. Note: Fewer stations sampled!
2. **Central Sound Region:** Slightly higher temperatures. High DO confined to mid-Central Basin surface water.
3. **Whidbey Basin:** Note: Fewer stations sampled!
4. **Hood Canal:** Higher DO, especially in the main stem yet lower fluorescence.
5. **South Sound:** Expected.

SUMMARY COASTAL BAYS REGIONS - Expected

1. **Grays Harbor:** Lower in situ fluorescence.
2. **Willapa Bay:** Expected.

Meteorological conditions: Warmer with marine air that caused cloudier skies in the morning burning off to warm sunny afternoons. Precipitation was sparse and episodic and heavy toward the end of the month with river flow jumping to above normal, especially in South Puget Sound.

SUMMARY GREATER PUGET SOUND REGION – Variable oxygen, low transmission confined to the north and overall higher fluorescence. Physical conditions all expected.

1. **San Juan-North Sound Region:** Saltier and more dense, variable DO with lower values confined to the north. Low transmission but variable fluorescence.
2. **Central Sound Region:** Higher DO and fluorescence. Low transmission confined to northern Central Sound.
3. **Whidbey Basin:** Lower transmission and higher fluorescence.
4. **Hood Canal:** Near hypoxic at depth. Higher transmission and lower fluorescence.
5. **South Sound:** Higher DO with low DO's confined to Carr & Budd Inlets.

SUMMARY COASTAL BAYS REGIONS - Warmer, higher oxygen, low fluorescence and high transmission. Physical conditions all expected.

1. **Grays Harbor:** Warmer, higher oxygen and higher transmission.
2. **Willapa Bay:** Warmer, variable oxygen with lower fluorescence.

Meteorological conditions: September was unusually wet and was initially warmer but temperatures cooled towards the end. River flow was normal, but responded to strong rainfall in the last days. Wind was predominantly out of the south and was downwelling favorable.

SUMMARY GREATER PUGET SOUND REGION - Warmer in North and South Sound. Higher density confined to Hood Canal. Oxygen varied regionally variable (lower in Central, higher in South Sound). Transmission was higher throughout Puget Sound.

1. **San Juan-North Sound Region:** Warmer water temperatures. Higher DO in San Juans near surface. Transmission was also higher.
2. **Central Sound Region:** Lower DO in N. Central Basin; higher in S. Central Basin. Transmission very high.
3. **Whidbey Basin:** Warmer surface, higher DO at depth. Generally higher transmission.
4. **Hood Canal:** Denser water, cooler at the surface. Variable DO and higher transmission.
5. **South Sound:** Higher temperatures, lower densities with higher DO, especially in surface layer. Transmission was higher.

SUMMARY COASTAL BAYS REGIONS - Warmer water temperatures with lower densities in Willapa Bay. Generally lower DO and in situ fluorescence.

1. **Grays Harbor:** Warmer water temperatures. Lower DO, and lower in situ fluorescence.
2. **Willapa Bay:** Warmer water temperatures and lower densities and lower in situ fluorescence.

Meteorological conditions: October was cooler than normal with persistent marine layer that kept sunlight at a minimum. After high precipitation at the end of September, conditions got dry and river flows fell below normal. Wind was light and generally from the north and upwelling was more favorable than normal.

SUMMARY GREATER PUGET SOUND REGION - Lower density near rivers with higher temperature being confined to Whidbey Basin. Oxygen higher in Central basin and lower in South Central and South Sound. High Transmission in North Sound and Hood Canal.

1. **San Juan-North Sound Region:** Cooler, surface water less dense and bottom water denser. High oxygen at surface in San Juan Islands and Admiralty sill; low level at depth toward Strait. Transmission very high.
2. **Central Sound Region:** Lower temperature at surface. Higher oxygen at mid-basin, lower oxygen toward south Central basin.
3. **Whidbey Basin:** Warmer water with lower oxygen in the north basin and higher in the south basin. Transmission very high.
4. **Hood Canal:** Less dense and fresher at surface. Higher oxygen at surface, with new lows at depth in south HC. Transmission very high and in situ fluorescence low.
5. **South Sound:** Less dense with lower salinity confined to southern inlets. Low oxygen and in situ fluorescence.

SUMMARY COASTAL BAYS REGIONS - Grays Harbor high salinity and lower oxygen, Willapa lower salinity. Yet, transmission is higher and fluorescence low in both bays.

1. **Grays Harbor:** Saltier and denser and lower oxygen. Transmission was very high.
2. **Willapa Bay:** Lower salinity, transmission very high and in situ fluorescence low.

Meteorological conditions: The first three weeks were cloudy, warmer-than-normal with SW winds and intermittent precipitation. Third half of November the weather turned clear and cold with lighter winds out of the north. River flow ran significantly below normal after the transition.

SUMMARY GREATER PUGET SOUND REGION - Cooler water in main stem of Puget Sound.

1. **San Juan-North Sound Region:** Colder, with higher salinity and density confined to San Juan Islands.
2. **Central Sound Region:** Generally expected DO, with some higher surface layers in N. Central Sound.
3. **Whidbey Basin:** Transmissivity was higher.
4. **Hood Canal:** Expected.
5. **South Sound:** Cooler water with higher oxygen levels in western inlets. In situ fluorescence is also higher.

SUMMARY COASTAL BAYS REGIONS - Cooler with higher oxygen levels.

1. **Grays Harbor:** Cooler, denser and higher oxygen.
2. **Willapa Bay:** Cooler with variable salinity and higher oxygen.

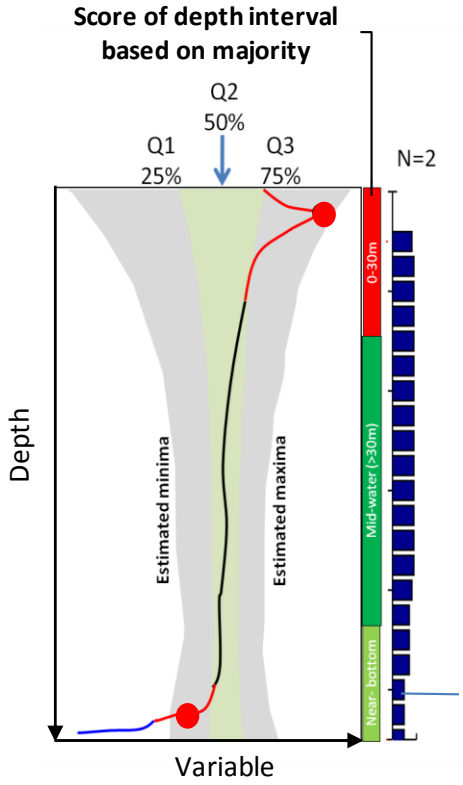
Meteorological conditions:
December was cold, dry, and overcast; river flows were down.

SUMMARY GREATER PUGET SOUND REGION - Saltier, denser, cooler. Oxygen higher than expected in South Sound and at depth in Hood Canal. Transmission and in fluorescence were variable and ranged from expected to new maximum values.

1. **San Juan-North Sound Region:** Saltier, denser, cooler and high transmissivity and high in situ fluorescence.
2. **Central Sound Region:** Saltier, denser, cooler.
3. **Whidbey Basin:** Saltier and denser confined to the surface, variable in situ fluorescence.
4. **Hood Canal:** Denser in northern parts. Higher oxygen at depth. Both transmissivity and in situ fluorescence higher.
5. **South Sound:** Saltier, denser, cooler and higher oxygen levels. Both transmissivity and in situ fluorescence higher.

SUMMARY COASTAL BAYS REGIONS - Colder in Willapa and high oxygen and higher transmissivity and higher in situ fluorescence, Grays Harbor not sampled.

1. **Grays Harbor:** Not available
2. **Willapa Bay:** Colder with higher oxygen, transmissivity and in situ fluorescence.



Line color code

- IQR
- Lower < IQR < Higher
- New min, New max
- N/A (No reference data)

Estimated extremes:
Lo = Q1-(1.5*IQR)= estimated 5%
Hi = Q3+(1.5*IQR)= estimated 95%
IQR = Q3-Q1

Number of replicates available for statistical reference

A wealth of historical data allows us to place new CTD observations into the historical context of Ecology's long-term data record.

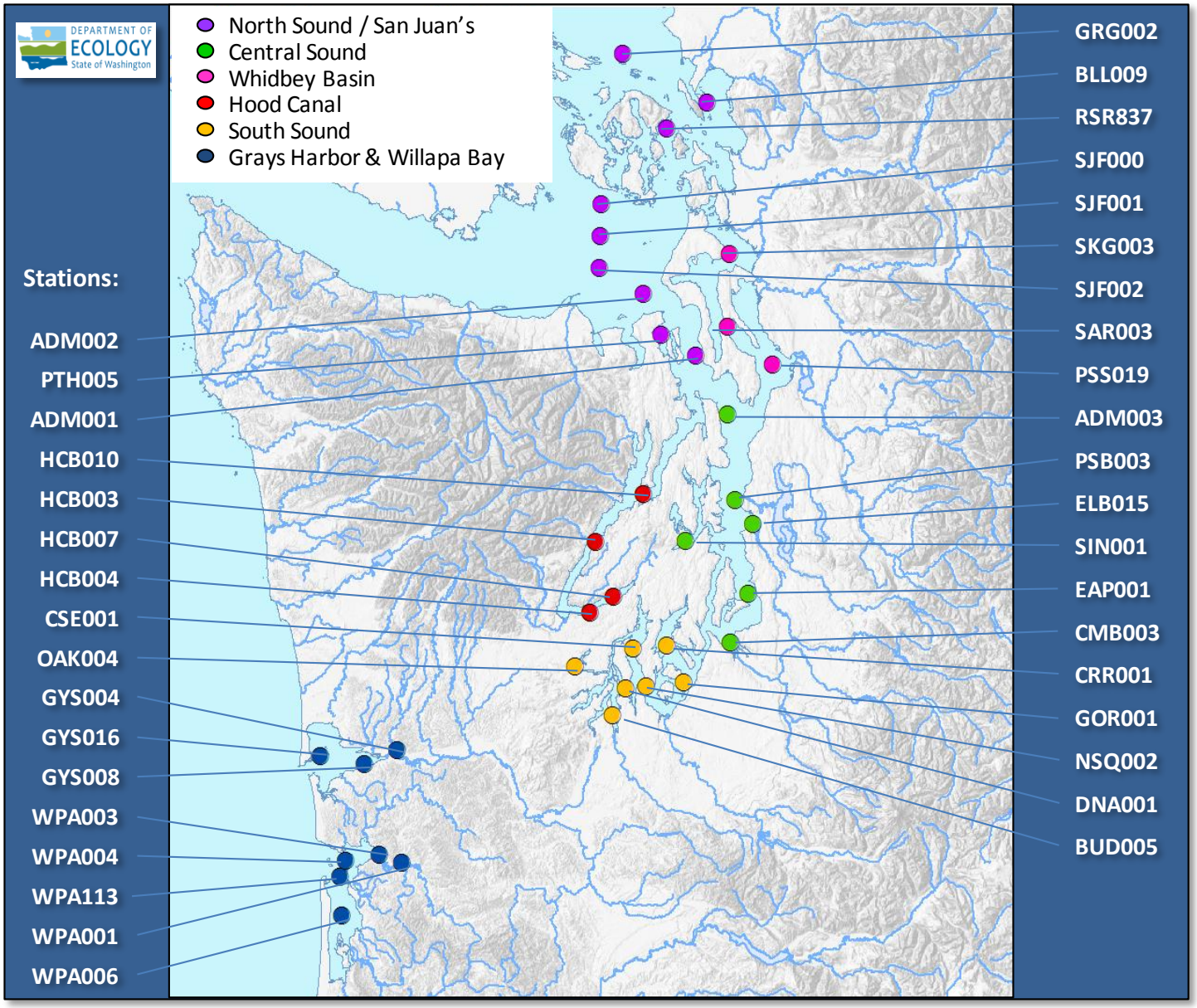
We use an increasing temporal reference framework of 1999-present to statistically define anomalies. Conditions that fall outside of a 50% observation envelope (second and third quartile) are considered "***anomalies***".

Graphically you can explore current anomalies in our monthly data updates.

Begin exploring anomalies, click here

How to read our graphics:

A **green background** describes the range into which 50% of our historical recorded data fall. Grey shows the 99% data envelope that we estimate from the interquartile range multiplied by 1.5. Pieces of the data line falling within the 50% envelope are colored **black**, data falling outside the 50% envelope are colored **red**. New extrema are emphasized with a red dot. If we sample a depth deeper than previously sampled we give the data line the color **blue**. Bars (dark blue) on the right indicate the number of observations (e.g. N=2). To illustrate if the entire water column section (<10m, 10-30m, >30m) is on average a "normal" or "***anomalous***" condition, we included a color coded vertical line. **Red** indicates on **average *anomalous* conditions**; **green** indicates on **average *normal* conditions**.



For detailed station information
click here

We use a float plane as a cost-effective means to collect marine samples throughout Washington's extensive marine waters.